SHIP (Safety and Health Investment Project): Application of failure modes and effects analysis to occupational health
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Disclosure
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Context of the Project
• The purpose of this project is to create highly effective training on proper use of personal protective equipment (PPE) to prevent healthcare worker (HCW) exposure to highly infectious agents and bodily fluids.

Problem
• Providing care to patients with highly contagious, highly lethal diseases presents a major, immediate challenge to healthcare institutions.
  — Low level PPE is commonly and safely used in the healthcare system, high level PPE required when caring for patients with Ebola virus is rarely if ever used
• Available information regarding safe use of PPE is in constant flux, thus inhibiting efforts to provide up to date training that maximizes HCW safety.
• PPE requirements for HCW treating Ebola virus patients include equipment that can limit peripheral vision, gross and fine motor skills, and spatial awareness and result in occupational injuries resulting from needlesticks and falls.
• Currently available training on PPE for US healthcare workers are inadequate and do not consider the physical limitations and additional safety risks posed by PPE.
• Can we use a risk analysis process to identify training challenges and mitigate them BEFORE they occur in practice?
Clinical Focus: Fecal Management

- Placing a fecal management system for an EVD patient
- Providing hygienic care for a highly infectious disease patient
- Change the receptacle bag
- Patient room set up and safe hygienic care for a patient with copious amounts of body fluids
- Place a clean bag

FMEA Overview

Video

FMEA Overview
### Process

<table>
<thead>
<tr>
<th>Process</th>
<th>Potential Failure Mode</th>
<th>Effect of Failure Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set up blankets on floor to dam liquids (do on both sides of bed)</td>
<td>Item not available in close proximity to provider</td>
<td>Procedure takes too long and patient declines</td>
</tr>
<tr>
<td></td>
<td>Becoming contaminated (feet)</td>
<td>Increased risk of agent spreading</td>
</tr>
<tr>
<td></td>
<td>Becoming contaminated, aprons/gowns too long hitting floor</td>
<td>HCW exposure</td>
</tr>
<tr>
<td></td>
<td>Spreading agent by kicking towels</td>
<td>HCW exposure</td>
</tr>
<tr>
<td></td>
<td>Tripping over towels</td>
<td>Physical injury and difficulty assisting provider</td>
</tr>
<tr>
<td></td>
<td>Incontinence pads don’t stay rolled and only absorbent on one side</td>
<td>Increased splatter and unrecognized gross contamination</td>
</tr>
</tbody>
</table>

### FMEA Overview

- **Select/Define the process**
- **Assemble the team**
- **Design simulation**
- **Identify stages in the process**
- **Identify failure modes for each step**
- **Identify effect of each failure mode**
- **Assign a risk priority score**
- **Develop mitigation strategies**
- **Implement and re-evaluate**

### Risk Priority Number

- **Severity**
  - 1-10, 10 most severe
  - What has the most severe impact on a patient
- **Occurrence**
  - 1-10, 10 most likely
  - How likely is it this will occur
- **Detectability**
  - 1-10, 10 is least likely to be noticed
  - How detectible is it, if this occurs?
- **RPN** = severity * occurrence * detection

### Exercise

- **Calculate risk priority score for each failure mode**
  - **Severity** (1 = not severe ➔ 10 = most severe)
  - **Occurrence** (1 = rare ➔ 10 = very common)
  - **Detectability** (1 = easily detected ➔ 10 = undetectable)

\[
RPN = (\text{severity}) \times (\text{occurrence}) \times (\text{detectability})
\]
### FMEA Overview

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<thead>
<tr>
<th>Process</th>
<th>Potential Failure Mode</th>
<th>Effect of Failure Mode</th>
<th>Severity</th>
<th>Occurrence</th>
<th>Detectability</th>
<th>RPN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item not available in close proximity to provider</td>
<td>Procedure takes too long and patient declines</td>
<td>7</td>
<td>8</td>
<td>3</td>
<td>168</td>
<td></td>
</tr>
<tr>
<td>Becoming contaminated (feet)</td>
<td>Increased risk of agent spreading</td>
<td>1</td>
<td>10</td>
<td>1</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Becoming contaminated, aprons/gowns too long hitting floor</td>
<td>HCW exposure</td>
<td>5</td>
<td>5</td>
<td>8</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>Spreading agent by kicking towels</td>
<td>HCW exposure</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td>192</td>
<td></td>
</tr>
<tr>
<td>Tripping over towels</td>
<td>Physical injury and difficulty assisting provider</td>
<td>10</td>
<td>5</td>
<td>1</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Incontinence pads don’t stay rolled and only absorbent on one side</td>
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<td>4</td>
<td>4</td>
<td>1</td>
<td>16</td>
<td></td>
</tr>
</tbody>
</table>

### What Now?

- **Rules of thumb**
  - Prioritize highest RPN
  - If failure has severity of 10, deal with it even if the overall RPN is low
  - Mitigation strategies

- **Possible Mitigation Strategy**
  - Set up blankets on floor to dam liquids (do on both sides of bed)
  - Laundry cart on both sides
  - Additional layer?
  - Positioning of observer for each step? (Is there an SOP if someone goes down?)
  - Checklist and procedures for how to dam
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Results

- 16 identified failure modes related to EVD patient hygienic care
- 30 discrete steps
- Same failure mode was often associated with multiple steps — e.g., provider contamination
- Failure modes ranged in RPN from 6 – 400
Summary

- FMEA is a useful tool for rapidly evaluating risks of a new process
- Event-based simulation allows us to see the new process in action and develop a more accurate FMEA
- Guidebook contains step by step information

Thank you

Sponsor
- Washington State Department of Labor & Industries

Simulation Participants
- Douglas Franzen, MD
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- Steven Mitchell, MD

QUESTIONS